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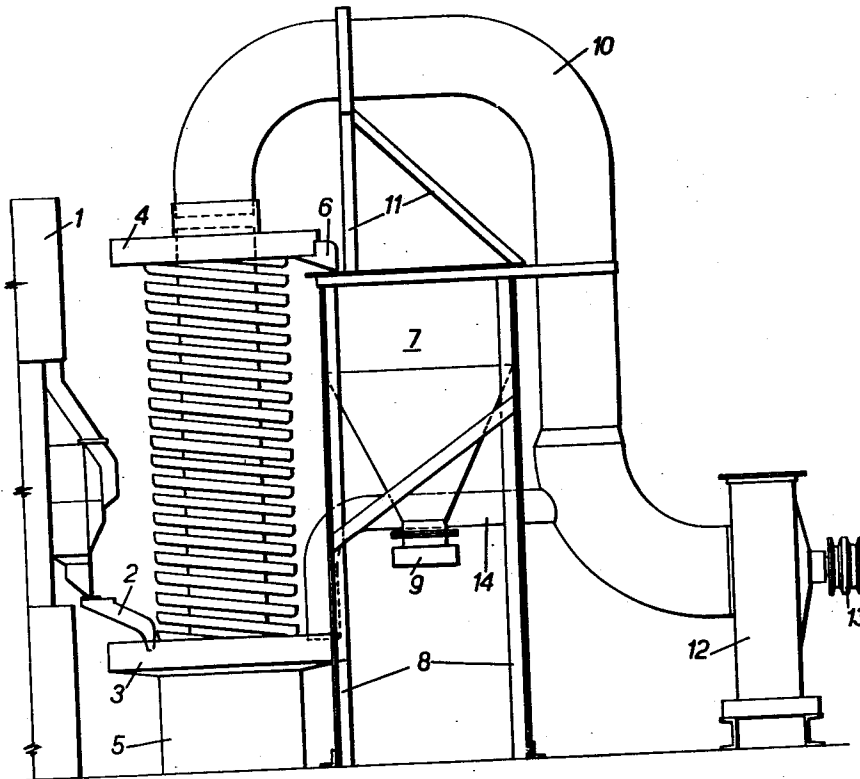
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COOLING OR DRYING OF BULK MATERIAL

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2 Sheets-Sheet 1

FIG. 1.



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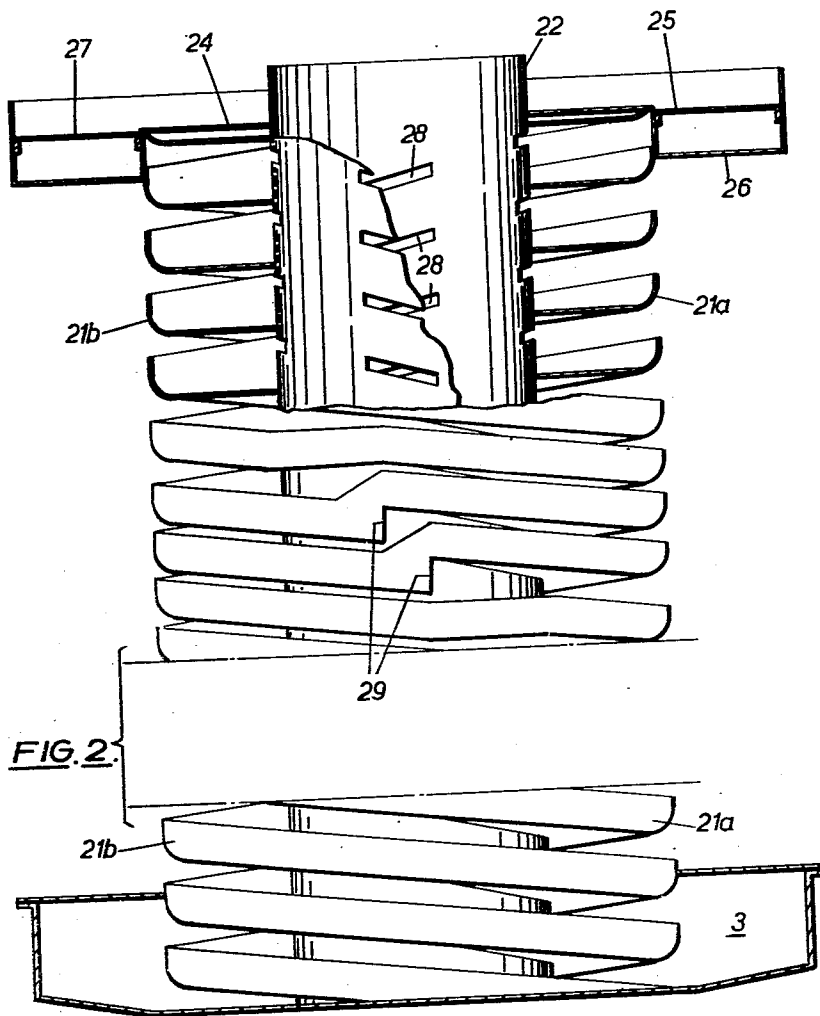
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COOLING OR DRYING OF BULK MATERIAL

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3 Claims. (Cl. 34—147)

The present invention relates generally to the modification of the physical condition of material in discrete form, with particular reference to the modifications of cooling and drying. Whilst these two specifically mentioned modifications may be regarded as being brought about by effecting a temperature change in the material, the invention is not in its broader aspects confined to the achievement of temperature change alone, but may be usefully employed wherever a continuous flow of a selected gaseous medium in contact with the material is capable of producing a particular modification of the physical condition prevailing in that material.

Hitherto, in order to effect modification in the physical condition of material in discrete form as now contemplated, it has been customary to heat the material whilst disposed in a static mass by forcing into it an appropriate gaseous medium. However, the larger the mass, so the greater becomes the pressure on material at the bottom of the mass and if the material is of a composition which is liable to disintegration under pressure, deterioration will be caused. Also, the effectiveness of the gaseous medium to an achievement of its purpose is progressively reduced as it passes through the mass of material. It will be evident that these disadvantages may be alleviated if the material is spread in thin layers or moved in a thin continuous stream when undergoing treatment by a gaseous medium; but on the one hand, spreading of the material into a thin layer requires ample floor space, whilst the hitherto known linear movement in a continuous stream on a pervious conveyor band involves the same requirement. Consequently, if the treatment is to be carried out efficiently, the aforementioned considerations demand that ample floor space shall be available. The present invention has for one of its objects to reduce this requirement.

The present invention consists in causing a stream of the material to ascend gradually an inclined winding track and, during ascent thereof, passing over the material in a direction generally transversely of the ascending path thereof currents of a gaseous medium appropriate to an achievement of the desired modification. In this way a long path may be compacted into a relatively small space to extend predominantly in the vertical direction and thereby economise on floor space requirement. Ascent by vibratory feeder action is preferred as being favourable to delicate or friable materials.

According to a feature of the invention, a stream of the material is caused to ascend gradually a spirally ascending track, and within the turns of the track a sub-atmospheric pressure is maintained, whereby a flow of ambient air is set up over the material in a direction substantially radially of the track. By a further feature of the invention, hot air is introduced continuously into the space within the turns of the track and is guided outwards over the track in a substantially radial direction in order to dry the ascending material.

It is found convenient to have a track winding up-

2

wardly around the inner or outer wall of a hollow casing, the track being adapted for vibration to cause the ascent along the track of a stream of the material, and to provide in the casing a series of apertures arranged adjacent the track along the entire length thereof to enable, by maintaining a pressure or suction within the casing, a gaseous medium to be blown or drawn over continuously the material ascending the track.

Depending on the depth of material ascending the track and also on the size of the particles, it may become necessary to agitate or otherwise rearrange the particles in the stream in order that they may all be exposed to the gaseous cooling or drying medium. This may be attained, for example, by including at intervals in the ascending track steps over which the material falls and thereby becomes turned over or re-arranged. An alternative way of achieving this agitating effect would be to arrange outside the track a second outer casing having a series of apertures each offset relative to adjacent apertures in the inner casing, so that the flow of air in the annular space between the two casings is tortuous, and possible turbulent, whereby the material moving on the track in this annular space becomes unsettled or agitated.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 shows a cooling system interposed between a material moulding machine, in this case an extrusion press for pellets or animal feed, and a packaging machine, represented in this case by a hopper for sacking of the pellets;

Fig. 2 shows the cooling system in greater detail. The delivery end of the extrusion press is seen in Fig. 1 and is designated generally 1. This machine delivers the pellets to a chute 2 opening at its lower end into a bowl 3 of the cooler which is open-topped at least in the region of the chute 2. The cooler comprises a continuous length of track spiraling upwardly from the bowl 3 to an upper delivery zone 4 in spaced superposed relationship with the bowl 3, the track being vibratable to cause ascent of the material thereon by means of a vibrator unit installed in operative association therewith within a casing 5. The vibrator unit may be operated electrically or mechanically and may act on the track directly or indirectly through a hydraulic transmission medium.

At the delivery zone 4 the material is guided to a delivery chute 6 discharging into a hopper 7 supported within a framework 8. Discharge from the hopper 7 is controlled by a gate valve or the like indicated by 9 which enables material within the hopper to be selectively withdrawn to fill by free fall a sack positioned below the hopper. The space within the turns of the upwardly spiraling track of the cooler is connected by means of a duct 10 supported by an extension 11 of the frame 8 to one side of a blower or fan 12. Motive means are provided to drive the blower or fan 12, for instance through V-belts passing about the pulleys 13. Since the present example is concerned with cooling the material, the duct 10 is connected to the suction side of the fan 12, so that when the fan is running a suction is maintained in the space within the turns of the upwardly spiraling track in order to draw a transverse flow of ambient air over the material ascending on the track.

As will be evident, the duct 10 would be connected to the pressure side of the fan or blower if drying were to be performed by the apparatus, and in that event air heated to a temperature in excess of that prevailing initially in the material would be admitted to the fan or blower, or alternatively heating of the air could take place within the duct itself. The capacity of the fan or blower

is commensurate with the treatment required having regard to such factors as the temperature differential of the ambient or pre-heated air and the material, the length of track and the flow of material.

In certain circumstances, particularly when cooling materials which in their initial warm state give off vapours or steam, it is preferably to apply a suction in the bowl 3, and for this purpose there is seen in Fig. 1 a pipe 14 connected at one end to the duct 10 and opening at the other end at a point within the bowl 3 sufficiently clear of the anticipated level of the material therein to prevent induction of the material into the pipe. This expedient serves to draw off steam or vapor, and may be employed also as a preliminary dust extraction.

The track may be formed of one or more lengths of tray extending helically in the manner of a single or multiple thread around a central cylindrical casing either externally or internally thereof. In Fig. 2, two such lengths of tray 21a, 21b are shown externally of a casing 22, the trays having upturned outer edges to minimise spilling of the material. The casing and trays are supported in the bowl 3 which has a dished base from which the helical trays start at substantially diametrically opposed points. Adjacent the top of the casing 22 the trays lead to a platform 24 on which deflectors (not seen in the drawing) are provided to direct material delivered from the trays on to a surrounding annular surface 25. This surface 25 is perforate or otherwise constructed to act as a sieve in order that any fines or dust accompanying the elevated material may be separated out for reception, for instance, into the container denoted 26. The surface 25 is interrupted at 27 to provide an outlet for the cooled or dried grains, pellets or small solids of the material, it being arranged that the material delivered on to the platform 24 travels on the perforate surface 25 before reaching the outlet 27.

The whole unit is vibratable to set up a feeder action on material loaded into the bowl 3 whereby it moves in a circular direction around the bowl, passing up the trays in a continuous stream for ultimate delivery on to the platform 24. The amplitude of the vibrations applied to the unit governs the rate of feed of the material.

The casing 22 has over its whole length slots 28 aligned circumferentially with the turns of the trays. The interior of the casing 22 being connected either to the suction or the delivery side of the blower or fan 12, air is either blown or drawn through the slots 28 to pass over the material ascending on the trays.

The stream of material ascending from the bowl 3 may be agitated at points along its travel on the trays 21a, 21b by providing steps, such as those denoted 29 in the drawing, at one or more points in each of the helically extending trays. The steps are arranged so that material ascending on the trays falls when passing over them, and in so falling becomes turned over and re-arranged, with the object of ensuring that constituent particles are all exposed to the flow of air across the trays in the course of their ascent.

The further possibility is visualised of providing, or otherwise forming the trays to include a duct for gaseous medium which then passes through apertures in the duct by pressure or suction created therein. Furthermore, gaseous medium may be induced over one section of the track and blown over the remainder.

It should also be noted that cooling of the material, whilst effected predominantly by forced convection, is

further assisted by conduction to the trays, especially if these be made of metal and also, on the other hand, heating for drying purposes is likewise assisted. That the cooling or drying is accompanied by elevation of the material offers the added advantage that further elevation for the purpose of sacking or storing of the material may be dispensed with, and also, as particularly described, the invention enables simultaneous separation of fines or dust.

The invention is applicable to a wide variety of materials provided only that whilst being treated in accordance with the invention they are not in a coherent or homogeneous form, but are composed of separate pieces or particles. For example, comestibles in small discrete quantities which have been cooked or baked may be cooled, as may also pellets of animal feed moulded in a warm condition, or bulk material such as cereal grain may be dried or even conditioned.

I claim:

1. In a vibratory conveyor for the treatment of material in discrete form for the purpose of modifying the physical condition thereof, and of the type comprising means defining a first receiving zone, means defining a second delivery zone, said two zones being in spaced superposed relationship, a hollow casing upstanding between said two zones, an ascendant track winding upwardly and closely proximate over its whole length to a bounding surface of said casing, and affording a continuous path for the transfer of the material between said two zones, and means to vibrate said track; apertures being located in said casing at points spaced apart over substantially the entire length thereof, each aperture being located above the maximum level at which material may be disposed on that portion of the track adjacent said aperture and means in communication with the interior of said casing adapted to maintain a pressure differential of a gaseous medium internally and externally of said casing in order to set up a flow of the gaseous medium through said slots and over the ascendant track in a direction generally transversely of said track.

2. In a vibratory conveyor as set forth in claim 1, said track including at least one step over which material falls during ascent of said track.

3. In a vibratory conveyor for the treatment of material in discrete form for the purpose of cooling and drying said material, and of the type comprising a bowl, a long hollow cylindrical column upstanding centrally in said bowl, an annular platform disposed in co-axial relationship at the top of said column, said annular platform having admission and discharge openings, a narrow tray having an outwardly directed edge upturned, said tray extending spirally about said column from a point in said bowl to the admission opening of said platform, and a vibrator unit mounted in operative association with said bowl; slots being located in said cylindrical column at points spaced apart over substantially the entire length thereof, each slot being disposed above the level of the portion of the upturned edge of the tray nearest to it, and said hollow cylindrical column being adapted for connection to gaseous medium pumping means.

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